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THE LEGITIMACY OF PHYSICAL EDUCATION CLASSES FOR UNIVERSITY STUDENTS

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Abstract

The aim of the study was to determine the influence of the current scope of P.E. classes organized at the University of Warmia & Mazury in Olsztyn (Poland) during a period of one semester on the level of 1st year students' motor abilities. A total of 337 full-time students aged 19-20 participated in the research. In order to calculate the students' BMI, basic anthropometric parameters such as their body mass and height were measured. The students' motor abilities were examined at the beginning as well as at the end of the summer semester of the academic year 2009/2010 using the following 13 motor tests: the standing long jump [cm], the 4x10 m shuttle run [s], the skipping with clapping of hands – 8 s [number of claps], sit-ups – 30 s [number of sit-ups], the medicine ball (4 kg) forward throw [cm], the medicine ball (4 kg) backward throw [cm], the bent-arm hang on bar [s], the downward bend from standing position [cm], the sit and reach [cm], Burpee test – 1 and 3 min. [number of cycles], and the forward-backward arm rotation over head holding a bar [cm]. The data were subjected to statistical analysis using the Statistica PL v. 10 software package. In the majority of motor trials (eight out of eleven) the students performed significantly worse after completing the semester-long P.E. course. In the other five trials the differences were found to be insignificant. Moreover, the study revealed that the participants' average BMI increased over the course of the experiment. Based on the above it can be concluded that the current university P.E. program seems to be ineffective as it failed to result in noticeable positive physical changes, although the possible influence of the P.E. classes on the students' attitudes toward physical education and their future lifestyles should not be ignored. If it is to lead to the desired physical changes in university youth, the amount of time devoted to physical education at the university must be increased, the classes distributed differently and their form rethought.
Key words: *physical education, P.E. program, university students, motor abilities*.

Introduction

Determining individual's level of motor fitness constitutes one of the main areas of focus in the field of physical culture. This stems from the fact that the level of motor fitness is an important indicator of human development and health. Despite changes regarding the definition and measurement of motor fitness observed over the past two decades (Raczek 2010; Szopa, Chwała, & Ruchlewicz, 1998), the actual testing continues to be a very important component in the process of managing motor development of children and youth (Bénéfice & Ndiaye 2005; Bratić, Pavlović, Kostić, & Pantelić, 2012; Podstawski & Borysławski 2012; Tudor, Ružic, Sestan, Sirola, & Prpic, 2009) as well as adults and the elderly (Church, Earnest, Skinner, & Blair, 2007; Leversen, Haga, & Sigmundsson, 2012). The continuous expansion of so-called civilization diseases, along with a systematic decrease in the level of physical activity make such studies even more valuable, especially considering they are often the primary method of

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determining the health state of selected populations (Erikssen, 2001). They are often focused on health aspects since health-related fitness is one of the factors which enables the optimum quality of life to be achieved (Caspersen, Powell, & Christenson, 1985).

Studies regarding motor fitness have expanded to include university youth, who constitute an important subject of observations from the perspective of public health. Research that involves students at the commencement of their university education is especially valuable considering the fact that this is the final developmental stage when models of healthy lifestyles can be established. Some of the most common studies regarding students' motricity include determing their level of general motor fitness (Gill, Singh, & Kaur 2010; Lisicki 2006; Podstawski, 2006), which often entail examining the morpho-functional characteristics of the organism (Negasheva & Mishkova, 2005). Research concerning the relationships between motor fitness and anthropometric parameters (Choszcz, Podstawski, and Konopka 2012; Podstawski, Choszcz, Siemianowska, & Skibniewska, 2012) or environmental factors (Podstawski, 2012) provides a valuable source of information. It is worth noting that longitudinal studies focusing on university students at the commencement of their studies (Wolański, Przewęda, Zaremba, & Trześniowski 1992) as well as cross-sectional studies (Cleassens & Lefevre, 2005; Cuberek & Machova 2009; Yagi, Takebe, & Minoru, 1989) conducted repeatedly on the selected groups of people over a given time period (e.g. decades) are regarded as the most valuable.

However, no studies have been conducted to determine what (if any) influence the physical education classes at universities exert on the level of the students' motor fitness. Higher education in member states of the European Union has undergone many important changes in the past decade, which also pertained to the physical education curricula. Even though the tendency for marginalizing physical education at university has come under strong public criticism, so far no analyses of the topic have been published that would initiate discussions resulting in possible suggestions for improvement. Therefore, the authors of this work found it reasonable to examine the legitimacy of physical classes for university students. That led to formulating the aim of this study, which is to determine the influence of obligatory P.E. classes organized and conducted in accordance with the Polish Higher Education Act at the University of Warmia & Mazury in Olsztyn, Poland, on the level of motor abilities of 1st year students.

Methodology of Research

Participants

The research was conducted in 2010 at the beginning and at the end of the summer semester, at P.E. facilities of the University of Warmia & Mazury in Olsztyn (UWM). It involved 337 first-year full-time students who were chosen using a random selection method from 260 groups of students attending obligatory P.E. classes. Statistical tables were used for this purpose (Zieliński & Zieliński, 2001). In the 25 randomly selected P.E. groups analyzed in the research, only those students who were absent on the day of the studies for whatever reason were excluded from the research. This resulted in examining over 94% of students aged 19-20 in the given groups. The vast majority of study participants were permanent residents of the Warminsko-Mazurskie voivodeship.

First-year students were specifically chosen because, as was mentioned in the introduction, they constitute a particularly valuable research group as their motor habits are still susceptible to shaping and altering. In addition, this study constitutes the fifth stage of cross-sectional studies, which have been biannually conducted since 2000 (Podstawski, 2006, 2012).

Instruments and Procedures

In order to determine (calculate) the participants' Body Mass Index (BMI), basic anthropometric parameters i.e. body mass and height, were measured using the RADWAG scale. Thirteen motor tests such as: the standing long jump [cm], the 4x10 m shuttle run [s], skipping with clapping of hands – 8 s [number of claps], sit-ups – 30 s [number of sit-ups], the medicine ball (2 kg) forward throw [cm], the medicine ball (2 kg) backward throw [cm], the bent-arm hang on bar [s], the downward bend from standing position [cm], the sit and reach [cm], Burpee test – 1 and 3 min. [number of cycles], and the forward-backward arm rotation over head holding a bar [cm], were applied at the beginning and at the end of the study period in order to determine the possible influence of the P.E. classes on the level of the students' specific motor abilities. The accuracy and reliability of the above specified motor tests have been confirmed by numerous studies on the topic (Pilicz 1997; Pilicz, Przewęda, Dobosz, & Nowacka-Dobosz 2002; Szopa, Chwała, & Ruchlewicz, 1998). Each student was instructed on the proper technique of executing given motor tasks during the classes preceding the actual test dates and each was given ample time to practice every motor task. Prior to performing the actual tests the participants took part in a 10-minute warm-up.

Ethics

The research was carried out with prior consent from the Ethical Committee of UWM, on student volunteers who agreed to participate in the study, which they confirmed by signing a written statement.

Statistical Analysis

Descriptive statistics were used to analyze the data (mean, standard deviation, minimum, and maximum values). A non-parametric test for independent samples was applied in order to determine the differences between the data of the applied tests as well as the anthropometric parameters. Statistical calculations were performed and the data analyzed using the Statistica PL v. 10 software package (Stanisz, 2010).

Results of Research

The results of basic anthropometric parameters measured in order to characterize the study group at the beginning and at the end of the study period have been presented in table 1.

Table 1. Body mass, height and BMI of students at the beginning and at the end of the summer semester 2010.

Anthropometric parameters	Beginning of semester	End of semester	(p)
	$\overline{X}$ ± S (min ÷ max)	$\overline{X}$ ± S (min ÷ max)	
Body mass [kg]	77.61 ± 7.72 (63.00 ÷ 119)	78.20 ± 7.78 (60.00 ÷ 121)	≈0.0001
Body height [cm]	180.39 ± 5.87 (164.00 ÷ 196.00)	180.39 ± 5.87 (164.00 ÷ 196.00)	*ns*
BMI [kg/m^2]	23.88 ± 2.48 (18.70 ÷ 37.22)	24.06 ± 2.41 (18.99 ÷ 36.57)	≈0.0001
If p < α = 0.05 – differences are statistically significant			

Explanation: $\overline{X}$ – arithmetic mean, S – standard deviation, min – minimum value, max – maximum value, p – probability of exceeding the calculated statistics, *ns* – non significant

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When comparing the average values of students' anthropometric parameters it can be stated that their body mass and consequently their BMI values, increased significantly at the end of the semester. Average BMI values indicated that the students analyzed in the study were in the upper range of the BMI norm (18.50 - 24.99) at the commencement as well as at the end of the study period (Tab. 1).

Table 2 presents the average values of results obtained by students in the individual motor trials at the beginning and at the end of the semester. The probability of differences which occurred between the results was also determined.

Table 2. Average results obtained by the students in the individual motor tests at the beginning and at the end of the semester.

Motor tests	Beginning of semester $\overline{X}$ ± S (min - max)	End of semester $\overline{X}$ ± S (min ÷ max)	Probability (p)
Standing long jump [cm]	218.32 ± 20.11 (160÷270)	217.60 ± 21.21 (156÷270)	0.0666
Sit ups - 30s [number of sits]	23.72 ± 3.77 (12 ÷ 34)	23.35 ± 3.89 (9 ÷ 34)	0.0013
4x10m shuttle run [s]	10.91 ± 0.95 (9 ÷ 15)	10.90 ± 0.95 (9 ÷ 15)	0.1909
Skipping with clapping of hands - 8s [number of claps]	26.45 ± 3.37 (14 ÷ 38)	26.15 ± 3.40 (13 ÷ 38)	0.0062
Zig zag run [s]	25.73 ± 1.74 (21 ÷ 31)	25.71±1.78 (21 ÷ 31)	0.2571
Forward-backward rotation of bar over head held in both hands [cm]	87.28 ± 10.75 (62 ÷ 127)	87.26 ± 10.66 (60 ÷ 120)	0.9183
Downwards bend from standing position [cm]	5.51 ± 5.04 (-14÷ 24)	5.18 ± 5.69 (-15 – 26)	0.0008
1 minute Burpee test [number of cycles]	24.85 ± 3.39 (14 ÷ 32)	23.88 ± 3.79 (11 ÷ 34)	≈0.0001
3 minute Burpee test [number of cycles]	49.83 ± 7.84 (28 ÷ 69)	48.70 ± 8.19 (30 ÷ 67)	≈0.0001
Cooper test 12 min. on rowing ergometer [m]	2334.85 ± 331.20 (1350 ÷ 3150)	2325.12 ± 338.41 (1400 ÷ 3100)	0.0005
Medicine ball 4 kg backward throw [cm]	1035.79 ± 175.99 (100 ÷ 1660)	1036.18 ± 172.87 (550÷ 1750)	0.9244
Medicine ball forward throw [cm]	867.91 ± 136.01 (530 ÷ 1310)	856.15 ± 144.14 (510 ÷ 1360)	≈0.0001
Pull up on bar [number of pules]	4.50 ± 2.93 (-1 ÷ 17)	4.06 ± 3.18 (0 ÷ 18)	≈0.0001
If p < α = 0.05 – differences are statistically significant			

Explanation: $\overline{X}$ – arithmetic mean, S – standard deviation, min – minimum value, max – maximum value

It was observed that significantly lower results were achieved at the end of the semester in the majority of the applied motor tests. This phenomenon was observed in the results of the following tests: sit ups – 30 s, skipping with clapping of hands - 8s, the downward bend from standing position, 1- and 3-minute Burpee test, Cooper test on 12 min. rowing ergometer, the medicine ball (4 kg) forward throw, and the pull up on bar. No statistically significant differences occured between the initial and final results of the five other trials: the standing long jump, the zig-zag run, the medicine ball (4 kg) backward throw, the 4 x 10 m shuttle run, and the forward-backward arm rotation over head holding a bar [cm].

Discussion

The purpose P.E. departments at colleges and universities is to organize and conduct P.E. classes for all students, in accordance with the current syllabus accepted by the Ministry of Higher Education. Research conducted by Starosta (2010) presents the daily physical activity norms as specified by various authors, which indicate how the biological minimum of daily motor ability and its influence on human health ought to be understood. For example, the Surgeon General weekly recommendation of physical activity for children and youth is approximately 60 min. of intense effort almost every day (Lee, Burgeson, Fulton, & Spain, 2007). Although these norms differ depending on the source, they clearly indicate that the amount of physical activity which Polish university students receive during the mandatory P.E. classes is insufficient as it fails to result in adaptational changes within the body at a level which would satisfy the expectation of our society (Grabowski, 2003). Under such circumstances it is no surprise that students who view physical education classess mainly as an opportunity to shape their body may conclude that this time could be more productive if it were devoted to intellectual development rather than exercise. Furthermore, students' unwillingness to engage in physical culture is one of the main student–related barriers (obstacles) encountered by physical education teachers (Jenkinson & Benson, 2010).

Research conducted with UWM students as participants confirmed the above assumptions. It revealed that P.E. classes in the form of 15 sessions, lasting 90 minutes each and conducted on a weekly basis, are insufficient to improve the students' level of motor fitness. Worse still, the scheduled 15 P.E. lesson units rarely take place consecutively, as they are frequently interrupted by up to three-week breaks due to winter holidays and other events. Moreover, a significant decrease in the students' motor abilities was observed in the majority of cases and only five trials revealed no significant differences. Such unwelcome changes were also observed in the case of body mass and, in consequence, the students' BMI. Although we can be almost certain that the physical activity assumed by the students during the given time period did not in itself have a degenerative effect on the students' motor abilities and weight, it was also not enough to counteract the strong negative influence of other environmental factors. For instance, changes for the worse in dietary habits are typical of students taking up studies. During this time many students replace home-made meals with unhealthy ready-made food alternatives (Huang et al., 2003). Moreover, once free from their parents' constant supervision, they often turn to drinking large quantities of alcohol (LaCaile, Dauner, Krambeer, & Pedersen, 2011).

Based on the studies on the lifestyles and habits of Polish university youth (Choszcz, Podstawski, & Konopka,. 2012; Lisicki, 2006; Podstawski, 2012), it can also be assumed that the majority of the students under investigation engaged in no additional forms of physical activity except for the obligatory P.E. minimum. To make matters worse, the P.E. minimum at Polish tertiary institutions has been gradually reduced since 1999, when it was established by the Ministry of Higher Education as a total of 240 hours (Podstawski & Sławek, 2012). Such restrictions are regarded as institutional barriers (Morgan & Hansen, 2008). A similar tendency has been observed in other areas of the world where many school systems decreased the amount of physical education, or even eliminated it from their curricula. Such actions signify that this aspect of higher education has been greatly marginalized by authorities (National Association for Sport and Physical Education & American Heart Association 2006; Stelzer, Ernest, Fenster, & Langford, 2004).

The current scope of physical education at universities has been proved ineffective in meeting our society's expectations and thus ought to be changed (Penney, 2011). The differences between the realized aims of P.E. classes and students' expectations (stronger, leaner and more attractive bodies) stem from stereotypes that students have with regard to P.E. classes, which scientific evidence has confirmed to be unattainable with the current amount of time alotted to physical activity at university. When such unrealistic aims fail to be met, it is no surprise that the students end up feeling disappointed and as a result the subject of P.E. becomes marginalized, which, in turn, leads to a similar approach among other members of our society (Grabowski 2003). The time and money set aside for physical education classes is further reduced and replaced with other subjects, which consequently inhibits any positive changes to which they could have potentially led, and the vicious cycle completes itself.

Based on the above, it is clear that the current scope and/or form of P.E. classes ought to be modified. In 1995 the American College of Sports Medicine and the Center for Disease Control and Prevention published national guidelines in Physical Activity and Public Health. To promote and maintain health, all healthy adults aged 18 to 65 need aerobic (endurance) physical activity of moderate-intensity for a minimum of 30 min. five days per week or vigorous intensity aerobic physical activity for minimum of 20 min. three days a week (Haskell et al., 2007). According to these recommendations it is possible that the present number of P.E. classes (90 min. per week) is sufficient providing they were to be divided into, e.g. three 30-min. sessions of vigorous exercise. However, an adequate level of effort may be impossible to achieve with unfit, physically inactive students, in which case dividing the 90 min. into shorter sessions would be ineffective, and the current scope would have to be increased up to at least 150 min. (divided into five sessions). This could include training more focused on developing aerobic abilities such as jogging or Nordic walking. However, so as to make this broader scope more effective, the individuals have to be disciplined and the P.E. teachers cannot afford to waste time on organizational matches and unnecessary small talk, and start the exercises immediately. However, even such a program cannot provide the desired results if it were to be conducted for a period of only two semesters. Therefore, it ought to be continued throughout the course of the studies, as recommended by a number of specialists (Center for Disease Control and Prevention (CDC) 2010; McGinnis, Kanner, & DeGraw, 1991; National Association for Sport and Physical Education, 2006).

It should be borne in mind, however, that the aim of physical education programs is not only to lead to positive changes within the students' organisms, but also, or perhaps even mainly, in their lifestyles. These positive behaviors can, in turn, result in regaining, maintaining, or improving health and physical fitness which, over time, can even result in the physical appearance so desired by students. When looking at the matter from this perspective, P.E. programs organized at the university level of education are worth as much as the amount of time students and graduates dedicate to physical activity of their own volition. The amount of physical activity assumed does not depend on one's level of physical fitness, but rather on how important it is perceived to be. In order to effectively persuade students to take on an active life style, the P.E. teacher must be trustworthy, likeable, and creative (teacher-related barriers), creating an atmosphere and activities that students will want to resume after the obligatory course finishes (De Corby, Halas, Dixon, Wintrup, & Janzen, 2005). Colleges and universities should above all instill positive values regarding a healthy lifestyle (Penney, 2011) and for this reason physical education at the university level should be by no means treated as a second-rate subject, notwithstanding the lack of visible changes brought on by the current scope of classes.

Conclusions

The current scope of P.E. classes failed to influence positively the level of students' motor abilities, which were found to have decreased over the course of the semester as indicated by the results achieved in the majority of the applied motor tests. Moreover, the students' body mass, and consequently their BMI, increased during the analyzed time period. If P.E. curriculum is to lead to the desired physical changes in university youth, the amount of time dedicated to physical education must be increased, the lessons distributed differently and their form rethought. Although the current P.E. program failed to significantly influence the students' bodies and motor abilities, its importance in instilling positive attitudes and behaviors regarding physical activity should not be marginalized. This research is not free from some limitations such as not including female students, or not differentiating forms of physical activity in which the students were engaged e.g. swimming, martial arts, team sports etc.. It would be also interesting to provide research from other institutions of higher education worldwide still including obligatory physical education classes in their curriculum, which would unable us to investigate to what extent this phenomenon is a national or global trend. Therefore, the research should be continued by expanding its scope into the above mentioned parameters.

References

Bénéfice, E., & Ndiaye G. (2005). Relationships between anthropometry, cardiorespiratory fitness indices and physical activity levels in different age and sex groups in rural Senegal (West Africa). *Annals of Human Biology*, *32*, 366-382.

Bratić, M., Pavlović, R., Kostić, R., & Pantelić, S. (2012). Anthropometric characteristics – the determinants of vertical and horizontal jumping ability. *Acta Kinesiologica*, *6* (2), 13-19.

Caspersen, C. J., Powell, K. E., & Christenson, G. M. (1985). Physical Activity, Exercise, and Physical Fitness: Definitions and distinctions for Health-Related Research. *Public Health Reports*, *100* (2), 126-131.

Centers for Disease Control and Prevention. (2010). *The association between school based physical activity, including physical education, and academic performance*. Atlanta, GA: U.S. Department of Health and Human Services.

Choszcz, D., Podstawski, R., & Konopka, S. (2012). Modeling of anthropometric determinants of rowing ergometer performance on a distance of 500 meters for physically inactive males. *Journal of Physical Education and Sport*, *12* (3), 274-283.

Church, T. S., Earnest, C. P., Skinner, J. S., & Blair, S. N. (2007). Effects of different Doses of Physical Activity on Cardiorespiratory Fitness Among Sedentary, Overweight or Obese Postmenopausal Women With Elevated Blood Pressure. *Journal of American Medical Association, 297*, 2081-2091.

Cleassens, A. L., & Lefevre, J. (1992). Secular trends in somatic and motor characteristics of physical education students. *American Journal of Human Biology*, *4* (3), 301-311.

Cuberek, R., & Machova, I. (2009). The motor performance progression of future undergraduate students of physical education. *Acta Universitatis Polackianae Olomucensis Gymnica*, *39*, 15-24.

De Corby, K., Halas, J., Dixon, S., Wintrup, L., & Janzen, H. (2005). Classroom teachers and the challenges of delivering quality physical education. *Journal of Education Research*, *98* (4), 208-220.

Erikssen, G. (2001). Physical fitness and changes in mortality: the survival of the fittest. *Sports Medicine*, *31* (8), 571-576.

Gill, M., Singh, D. N., & Kaur, R. (2010). Comparative study of physical fitness components of rural and urban female students of Punjabi University, Patiala. *Anthropologist*, *12* (1), 17-21.

Grabowski, H. (2003). Leczyć czy amputować. *Forum Akademickie*, *11* (12), 47-49.

Haskell, W. L., Lee, I. M., Pate, R. R., Powel, K. E., Blair, S. N., Franklin, B. A., Macera, C. A., Heath, G. W., Thompson, P. D., & Bauman A. (2007). Physical activity and public health: updated recommendation for adults from the American College of Sports Medicine and the American Heart Association. *Medicine and Science in Sports and Exercise*, *39* (8), 1423-1434.

Huang, T. K., Harris, K. J., Lee, R. E., Nazir, N., Born, W., & Kaur, H. (2003). Assessing overweight, obesity, diet, and physical activity in college students. *Journal of American College Health*, *52*, 83-86.

Jenkinson, K. A., & Benson, A. C. (2010). Barriers to providing physical education and physical activity in Victorian State secondary schools. *Australian Journal of Teacher Education*, *35* (8), 1-17.

LaCaille, L. J., Dauner, K. N, Krambeer, R. J., & Pedersen, J. 2011). Psychosocial and environmental determinants of eating behaviours, physical activity, and weight changes among college students: a qualitative analysis. *Journal of American College Health*, *59* (6), 531-538.

Lee, S., Burgeson, C., Fulton, J., & Spain, C. (2007). Physical education and physical activity: results from the School Health Policies and Programs Study 2006. *Journal of School Health*, *77*, 435-463.

Leversen, J. S. R., Haga, M., & Sigmundsson, H. (2012). From children to adults: motor performance across the Life-Span. *PLOS ONE*, *7* (6), e38830.

Lisicki, T. (2006). *Studenci I roku akademii medycznych wobec wymogów zdrowego stylu życia*. AWFiS Press, Gdańsk.

McGinnis, J. M., Kanner, L., & DeGraw, C. (1991). Physical education's role in achieving national health objectives. *Research Quarterly for Exercise and Sport*, *62* (2), 138-142.

Morgan, P. J., & Hansen, V. (2008). Classroom teachers' perceptions of the impact of barriers to teaching physical education on the quality of physical education programs. *Research Quarterly for Exercise and Sport*, *79* (4), 506-516.

National Association for Sport and Physical Education & American Heart Association. (2006). *2006 shape of the nation report: Status of physical education in the USA*. Reston, VA: National Association for Sport and Physical Education.

Negasheva, M. A., & Mishkova, T. A. (2005). Morphofunctional parameters and adaptation capabilities of students at the beginning of the third millenium. *Journal of Physiological Anthropology and Applied Human Sciences*, *24* (4), 397-402.

Penney, D. (2011). Physical education and sports in schools: policies and pedagogy. *European Physical Education Review*, *16* (3), 309-310.

Pilicz, S. (1997). *Pomiar Ogólnej Sprawności Fizycznej*. Studia & Monografie Nr 65. Warsaw: AWF Press.

Pilicz, S., Przewęda, R., Dobosz J., & Nowacka-Dobosz S. (2002). *Physical Fitness Score Tables of Polish Youth. Criteria for Measuring Aerobic Capacity by the Cooper Test*. Studies & Monographs No 86. Warsaw: AWF Press.

Podstawski, R., Sławek, M. (2012). The influence of political transformation in Poland on the functioning of the Department of Physical Education and Sport at the University of Warmia & Mazury in Olsztyn during the academic years of 1998/1999 and 1010/2011. In B. Sokołowska, Ed., *Public Health in the Aspects of Modern Civilization* (pp. 266-278). Biała Podlaska; PSWJPII Press.

Podstawski, R. (2006). *Physical ability and opinions on health prevention among the 1st year students at the University of Warmia & Mazury in Olsztyn in academic year 1999/2000.* Olsztyn: UWM Press.

Podstawski, R. (2012). Influence of location and type of high school completed on changes in anaerobic abilities. *Aktywność Ruchowa Ludzi w Różnym Wieku*, *16*, 175-186.

Podstawski, R., & Borysławski, K. (2012). Relationships between selected anthropometric features and motor abilities of children aged 7 – 9. *Clinical Kinesiology*, *66* (4), 82-90.

Podstawski, R., Choszcz, D., Siemianowska, E., & Skibniewska, K. (2012). Determining the effect of selected anthropometric parameters on the time needed to cover 1000 m on a rowing ergometer by physically inactive young women. *Isokinetics and Exercise Science*, *20*, 197-204.

Raczek, J. (2010). *Antropomotoryka. Teoria motoryczności człowieka w zarysie*. Warszawa, PZWL, 2010.

Stanisz, A. (2010). *Practical course in statistics with STATISTICA PL using examples from medicine*. Cracow: StatSoft Polska.

Starosta, W. (2010). How one should understand the biological minimum of daily movement activity and how important it is for the human health? *Aktywność Ruchowa Ludzi w Różnym Wieku*, *14*, 49-65.

Stelzer, J., Ernest, J. M., Fenster, M. J., & Langford, G. (2004). Attitudes toward physical education: a study of high school students from four countries - Austria, Czech Republic, England, and USA. *College Student Journal*, *38* (2), 171-179.

Szopa, J., Chwała, W., & Ruchlewicz T. (1998). Investigations on structure of „Energetic" motor abilities and validity of their testing. *Antropomotoryka*, *17*, 3-41.

Tudor, A., Ružic, L. Sestan, B., Sirola, L., & Prpic, T. (2009). Flat-Footedness is not a disadvantage for athletic performance in children aged 11 to 15 years. *Pediatrics*, *123*, e386 – e392.

Wolański, N., Przewęda, R., Zaremba, H., & Trzesniowski, R. (1992). Regression of body build and motor fitness in 7-19-year-old Polish youth on energy use and demographic properties of regions. *Studies of Human Ecology*, *10*, 207-219.

Yagi, T., Takebe, Y., & Minoru, I. (1989). Secular trends in physique and physical fitness in Japanese students during the last 20 years. *American Journal of Human Biology*, *1* (5), 581-587.

Zieliński, R., Zieliński, W. (2001). *Tablice statystyczne*. Warszawa: Fundacja Rozwój SGGW Press.

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